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SYSTEM FOR AUTOMATED CELL CULTIVATION AND ANALYSIS

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Since Wilhelm Roux cultivated embryonic chicken cells in 1885, cell culture experiments elaborated to solve complex problems of biological, medical and pharmaceutical research. While industrial processes were widely automated in the same period, cell culture is still mainly conducted by manual labour. Especially for mechano-sensitive cells, and present state of knowledge suggests that any cells are mechano-sensitive, this might be disadvantageous, since handling processes impair inertial forces which cannot be reproduced precisely.
One way to resolve this problem is the development of a modular, automated cell cultivation tool for a variety of experiments. A strictly bio centered approach is applied: the cells are mechanically fixed in micro cultivation chambers in the center of the system. Subsystems for sustaining the optimum cultivation conditions are placed close to it and analytical tools move around (see Figure 1).

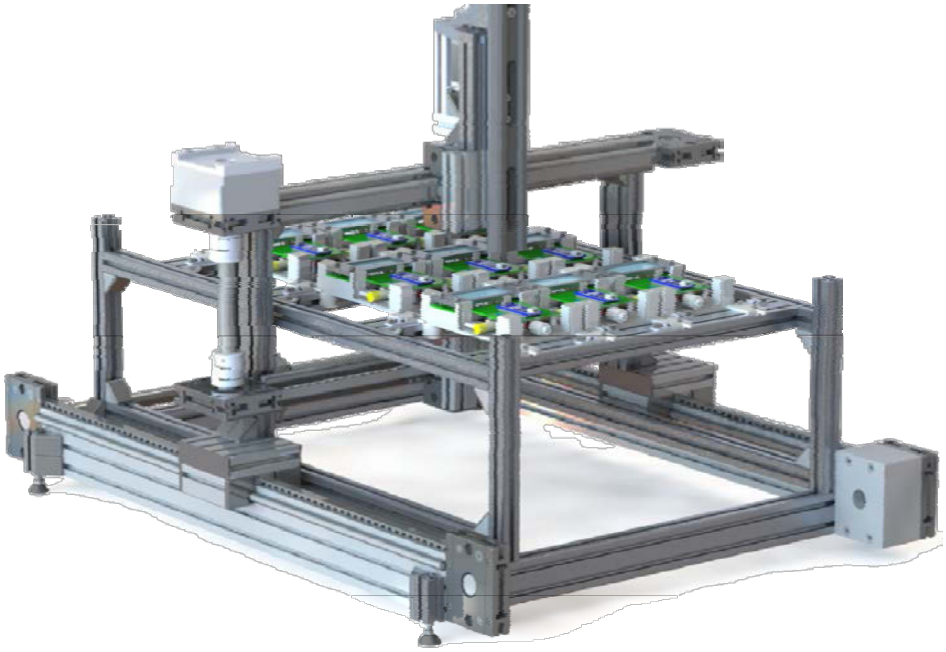

Figure 1: System for Automated Cell Cultivation and Analysis, x-y-z drive system with nine cultivation modules (fluidic supply systems not shown)

The setup consists of an open framework for housing the x-y-drives carrying the analytic head with z- motion option. The module slots allow experiments with up to nine cultivation chambers which are mounted into frames on the scale of standard ANSI/SLAS microplates (see Figure 2). The cells are cultivated inside of fitted microstructures (BioMOEMS – BioMicroOptoElectroMechanicalSystems) equipped with scaffold structures manufactured by two-photon polymerization.
The cultivation modules can be used as standalone solution ('incubators') or interconnected with other
modules to allow sophisticated experiments, e.g. co-cultivation of different cell types. The interconnection can be a fixed setup for each experiment or realized by a fluidic switching logic module in-between, enabling ramping, real-time fluidic control and setup changes during the experiment.

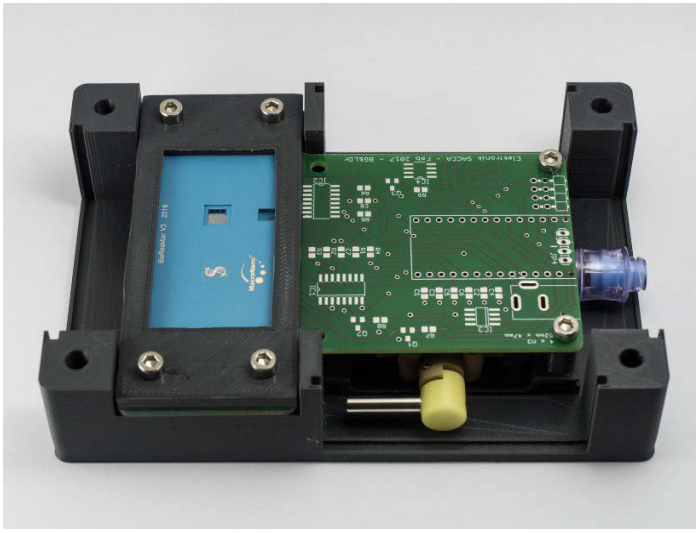

Figure 2: cultivation module with cell cultivation chip (left side)

The supply infrastructure provides proper physical, chemical and biological environmental parameters. These parameters act as a stimulus for cell reactions like differentiation or synthesis of specific metabolites and thus enable the investigation of cellular stimulus-response-mechanisms. The present research focus is on the differentiation pathways of ovine mesenchymal stem cells.
The cells are observed and their behavior characterized via distributed sensors inside the modules and (optionally) by an integrated analytic tool (moving optical system) with imaging and spectral optics. Cultivation processes are controlled via a touchscreen interface and distributed microcontrollers inside the modules and components

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